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## *Paeonia* (Paeoniaceae) in Xizang (Tibet)

Hong De-yuan

Laboratory of Systematic and Evolutionary Botany, Institute of Botany, Chinese Academy of Sciences, Beijing 100093, People's Republic of China

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ABSTRACT. A taxonomic revision of *Paeonia* in Xizang is presented, and of the five species recognized, *P. ludlowii*, *P. sterniana*, *P. delavayi*, *P. emodi*, and *P. veitchii*, the first two are endemic. A new combination, *P. ludlowii* (Stern & Taylor) Hong, is proposed. A considerable search for *P. moutan* var. *atava* in its type locality led to the conclusion that the taxon is *P. rockii* subsp. *rockii*, a native of north-central China introduced to Xizang by Buddhist monks. Reproductive and other biological features of the woody *P. ludlowii* and *P. delavayi* are described. A key to species is given.

Xizang (Tibet), commonly called the roof or the third pole of the world, has a rather rich flora due to its diverse topographic and climatic conditions. More than 5000 species of vascular plants have been recorded in *Flora Xizangica* (Wu, 1981–1987). Five taxa of *Paeonia*, *P. delavayi* Franchet var. *delavayi* and var. *lutea* (Delavay ex Franchet) Finet & Gagnepain, *P. emodi* Wallich ex Royle, *P. sterniana* Fletcher, and *P. veitchii* Lynch, have been reported from Xizang (Pan, 1979, 1985). During the preparation of a monograph of *Paeonia*, it became apparent that the two woody taxa which were originally described from Xizang have been neglected in the Chinese literature. *Paeonia moutan* Aiton subsp. *atava* Brühl was described from Yadong in S Xizang (Brühl, 1896), whereas *P. lutea* Delavay ex Franchet var. *ludlowii* Stern & Taylor was described from Mailing County and adjacent regions in SE Xizang (Stern & Taylor, 1951, 1953). *Paeonia moutan* is a synonym of *P. suffruticosa*, a species well known in cultivation. One of the problems that needed explanation is the disjunction between the Xizang populations of *P. moutan* subsp. *atava* and the wild forms (*P. suffruticosa* subsp. *spontanea* (Rehder) S. G. Haw & L. A. Lauener) that are confined to a small area in Shaanxi, Shanxi, and Henan. The second problem involves the taxonomic rank of *P. lutea* var. *ludlowii* because, according to Stern and Taylor (1953), this taxon is distinctly different from variety *lutea*, especially in plant height, size of flowers, and number and size of follicles. To clarify these and other problems, fieldwork was

conducted in S and SE Xizang from May to June in 1996.

### *PAEONIA MOUTAN* AITON SUBSP. *ATAVA* BRÜHL

Brühl (1896) described this subspecies based on King 549 (K), which was collected from Tibet (Chumbi, Tuk Chang, June 1884). Haw and Lauener (1990) treated the plant as *Paeonia suffruticosa* Andréanszky subsp. *atava*. The wild plants of *P. suffruticosa* subsp. *spontanea* are confined to a small area in N Henan, S Shanxi, and C Shaanxi. In fact, the whole *P. suffruticosa* complex (including *P. rockii*, *P. ostii*, and *P. qiui*) is confined to the Qinling Range and adjacent regions in North-central China, and none of its taxa has been recorded from Sichuan or Xizang. Several expeditions to Yadong County, where Chumbi is located, have been made since the early 1950s, but no *Paeonia* was found. The populations of subspecies *spontanea* and subspecies *atava* are isolated by more than 2000 air km and by the Qinghai-Xizang Plateau and the Himalayas.

During the 1996 expedition, the present author and three assistants spent considerable time in Chumbi Valley searching for *Paeonia*, but none was found. An extensive search was made in nearly every plant community in the valley to 3600 m elevation. The search was also extended to other places in Yadong County from Xiayadong at 2750 m, near the border with Bhutan and Sikkim, to Shangyadong at 3200 m. The peony is a famous flower in China, and wherever it exists in the wild, almost all the local people know its exact location. For example, during the expedition of 1995, inhabitants of NW Sichuan could point out the exact places where *P. decomposita* grew, and people in Mailing, Nyingchi, and Bomi counties in SE Xizang were also able to identify Lumaidao (God's flower). All 37 persons questioned indicated that no peony grows in the area. On the way back to Lhasa, a single plant of *P. rockii* (S. G. Haw & L. A. Lauener) T. Hong & J. J. Li was found in front of the Zhashilenbu Temple in Xigaze City. When asked about that plant, a Buddhist monk replied that it has "a very long history." *Paeonia rockii* has two

subspecies, and Brühl's figure (t. 126) fits *P. rockii* subsp. *rockii* rather well except for the flower color. The petals of *Paeonia* may change color if specimens are not dried quickly. Haw and Lauener (1990) commented on a specimen, *Gould 132* (K), from Bhutan as "having a large flower with blotched petals. It appears to be closer to [*P. suffruticosa*] subsp. *rockii*, but the leaflets are quite frequently lobed, with up to ca. 5 rather blunt, shallow lobes per leaflet." They also considered this plant as a possible escape from cultivation at a lamasery, and their description fits *P. rockii* subsp. *rockii* very well. On the basis of these findings, it is rather reasonable to say that "*P. moutan* subsp. *atava*" is actually *P. rockii* subsp. *rockii* introduced to Xigaze, Yadong, and nearby Bhutan by Buddhist monks from lamaseries in the Qinling Range.

KEY TO THE SPECIES OF *PAEONIA* IN XIZANG

- 1a. Shrubs; flowers yellow, rarely red-purple.
  - 2a. Carpels 2–4; follicles  $< 4 \times 1.5$  cm; petals usually red-blotched at base, rarely red-purple; filaments purple-red; plants  $< 1.5$  m tall; leaf segments and lobes mostly entire . . . . . *P. delavayi*
  - 2b. Carpels 1, rarely 2; follicles  $4.7\text{--}7 \times 2\text{--}3.3$  cm; petals pure yellow; filaments yellow; plants usually 1.5–3.5 m tall; leaf segments and lobes with acuminate teeth . . . . . *P. ludlowii*
- 1b. Herbs; flowers red, white, or pink.
  - 3a. All leaflets segmented, with segments again segmented, narrowly lanceolate to lanceolate,  $3.5\text{--}10 \times 0.4\text{--}1.7$  cm; flowers purple-red . . . . . *P. veitchii*
  - 3b. Only terminal leaflets 3-segmented, lateral ones not segmented or unequally 2-segmented, narrowly oblong or oblong-lanceolate,  $9\text{--}13 \times 1.2\text{--}3$  cm; flowers white or rarely pinkish white.
    - 4a. Carpels densely pubescent; flowers 3 on a stem . . . . . *P. emodi*
    - 4b. Carpels glabrous; flowers usually solitary . . . . . *P. sterniana*

***Paeonia ludlowii*** (Stern & Taylor) Hong, stat. nov.  
Basionym: *Paeonia lutea* Delavay ex Franchet var. *ludlowii* Stern & Taylor, J. Roy. Hort. Soc. 76: 217. 1951. TYPE: China. SE Tibet [Kongbo Prov., Miling, Tsangpo Valley], *Ludlow, Sherriff & Taylor 4540* (holotype, BM).

Deciduous and caespitose shrubs, up to 3.5 m tall. Roots attenuate downward, not fusiform. Stems gray, up to 4 cm diam. Leaves biternate, glabrous on both sides, green above, pale glaucous beneath; petiole 9–15 cm long; leaflets 9, leaf blade  $12\text{--}30 \times 14\text{--}30$  cm, lateral 3 leaflets on each side with main petiolules 2–3 cm long, terminal 3 leaflets with main petiolules 5–9 cm long; leaflets nearly

sessile,  $6\text{--}12 \times 5\text{--}13$  cm, usually 3-segmented nearly to base; segments  $4\text{--}9 \times 1.5\text{--}4$  cm, mostly 3-lobed to middle; lobes  $2\text{--}5 \times 0.5\text{--}1.5$  cm, entire or with 1 or 2 teeth, segments, lobes, and teeth all acuminate at apex. Flowers 3 or 4 on each shoot, axillary, 10–12 cm across; pedicels slightly curved, 5–9 cm long; bracts 4 or 5 and sepals 3 or 4, grade into one another; petals pure yellow, spreading, obovate, rounded at apex,  $5\text{--}5.5 \times 2.5\text{--}3.5$  cm; filaments yellow, 1.1–1.5 cm long, anthers ca. 4 mm long; disc only 1 mm high, yellow, dentate; carpels mostly single, very rarely 2, glabrous; stigmas yellow. Follicles cylindrical,  $4.7\text{--}7 \times 2\text{--}3.3$  cm. Seeds rounded, dark brown, ca. 1.3 cm diam. Flowering late May to early June.

In their description of *Paeonia lutea* var. *ludlowii*, Stern and Taylor (1951, 1953) indicated that the taxon is distinctly different from variety *lutea* and distinguished it by its long, commonly unbranched stems to 8 feet (vs. to 5 feet in var. *lutea*), larger and more open flowers, and up to 2 carpels twice as large as those of variety *lutea*. Upon the examination of plants in five populations in Mailing and Nyingchi counties, as well as five populations of variety *lutea* (= *P. delavayi*), these differences have been confirmed. As shown in Figures 1 and 2, plants of *P. ludlowii* are tall, caespitose, and with larger, pure yellow flowers, yellow filaments, acuminate leaf segments and lobes, and mostly one carpel per flower (more than 97% of the flowers examined have a single carpel and less than 3% have two). Furthermore, *P. ludlowii* produces very large follicles that contain the largest seeds in the genus. In contrast, plants of *P. delavayi* are not caespitose and have much shorter stems, acute leaf lobes and segments, more or less pendulous and smaller flowers on curved pedicels, yellow petals nearly always red-blotched at base, purple-red filaments, and 3 or 4 (rarely 2) much smaller carpels. These differences clearly support the recognition of variety *ludlowii* as a distinct species.

*Paeonia ludlowii* is a narrow endemic of SE Xizang, where it grows in sparse forests, woods, and thickets in Nyingchi, Mailing, and Lhunze counties at  $92.4^{\circ}\text{--}94.8^{\circ}\text{E}$  and  $28.4^{\circ}\text{--}29.9^{\circ}\text{N}$ . All five populations studied were small in size, and the largest was about 200 m in diameter. Except for the Quenima Village population (*Hong et al. H96020*), which had only four individuals, the other populations consisted of rather dense individuals, and the species was a dominant element in the community. Two factors may explain the compact population with a large number of individuals. First, this species has

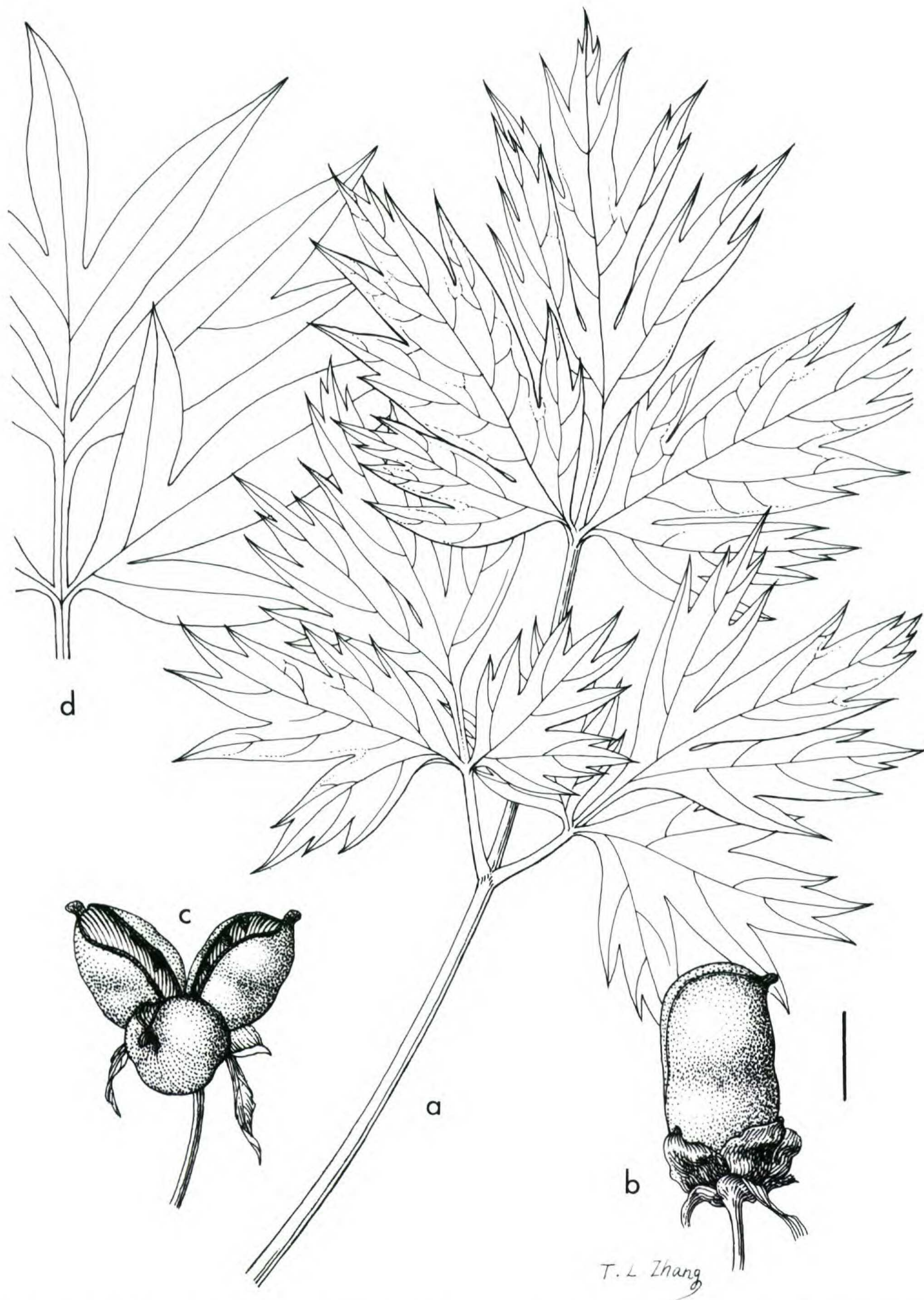


Figure 1. a, b. *Paeonia ludlowii* (Stern & Taylor) Hong. —a. Whole leaf. —b. Fruit of 1 follicle. c, d. *P. delavayi* Franchet. —c. Fruit of 3 follicles. —d. Part of leaf. Scale = 2 cm (drawn by Zhang Tai-li).

a high seed-set, and its seeds appear to have a high germination rate. Nearly 100 seedlings were found in an area of a square meter under a large individual in the Nanyigou population (Hong *et al.* H96030). Second, the seeds of *P. ludlowii* are large

(ca. 1.3 cm diam.) and are not adapted to long-distance dispersal; perhaps they are mostly moved by rats. The species is obligately sexual, and no vegetatively produced individuals or plantlets have been found in any of the populations. More than 20



Figure 2. *Paeonia ludlowii* (Stern & Taylor) Hong. Clockwise from left: —A clump with dozens of stems and > 100 flowers. —Flower with yellow petals and stamens and one pistil. —Hundreds of clumps dug out for root bark medicine, thus causing a serious threat to the survival of the species.

small plantlets were dug out, and all were found to be seedlings, a sharp contrast to *P. delavayi*, which also reproduces vegetatively.

*Paeonia ludlowii* is a tall shrub that often forms large and dense clumps with dozens of stems. A single individual may have up to 105 flowers (Fig. 2). The species is also a medicinal plant dug out by the local people for its root bark. In three of the five populations studied (*Hong et al. H96007, H96014, H96030*), hundreds of individuals were dug out by people from Gansu and Qinghai provinces (Fig. 2). This causes a serious threat to the survival of this species. Effective measures must be taken to conserve this beautiful flower.

*Paeonia ludlowii* is diploid with  $2n = 10$ . The meiotic chromosome count, reported here for the first time, is based on *Hong, Luo & Zhang H96007* (PE).

*Specimens examined.* CHINA. **SE Xizang:** Mailing County: Gangga, 4 km E of Gangga Bridge, 29.3°N, 94.4°E, 2900 m, *Hong, Luo & Zhang H96005* (GH/A, K, MO, PE, S); Zhare Township, Caimu Village, N of Yarlung Zangbo (River), 29.2°N, 94.3°E, 2980 m, *Hong, Luo & Zhang H96007* (GH/A, K, MO, PE, S); between Gangga and Mailing, S of Yarlung Zangbo (River), 29.2°N, 94.2°E, 3000 m, *Hong, Luo & Zhang H96014* (GH/A, K, MO, PE, S), *Zheng 22* (Herb. Xizang Plateau Inst. Ecol. Bayi); Nanyi Township, Nanyigou (Valley), 29.2°N, 94.1°E, 2950 m, *Hong, Luo & Zhang H96030* (GH/A, K, MO, PE, S), 3300 m, *Zheng 673* (Herb. Xizang Plateau Inst. Ecol. Bayi); Regagou, 2870 m, *Xizang Inst. Ecol. 186* (Herb. Xizang Plateau Inst. Ecol. Bayi); Lhunze County: Qayu, Zuanbadala, 3450 m, *Qinghai-Xizang Expedition 750450* (PE, KUN); Nyingchi County: Bayizhen, Juemugou, 2950 m, *Yao, Tang, Zheng & Pan 1005* (Herb. Xizang Plateau Inst. Ecol. Bayi), 3000 m, *Zheng 19* (Herb. Xizang Plateau Inst. Ecol. Bayi); Dongjug Township, Quenima Village, 29.9°N, 94.8°E, 3100 m, *Hong, Luo & Zhang H96020* (GH/A, K, MO, PE, S).

***Paeonia delavayi* Franchet, Bull. Soc. Bot. Fr. 33: 382. 1886.** TYPE: China. Yunnan: in dumetis ad juga nivalia Likiang, alt. 3500 m, 9 July 1888, *Delavay 1142* (holotype, P).

*Paeonia lutea* Delavay ex Franchet, Bull. Soc. Bot. Fr. 33: 382. 1886. TYPE: China. Yunnan: in calcareis montis Che-tcho-tze supra Tali, 9 May 1883, *Delavay-Paeonia 7* (holotype, P).

In addition to the differences from *Paeonia ludlowii* (see above), *P. delavayi* differs in reproducing vegetatively. All five populations studied in Nyingchi and Bomi counties were found within or near villages. In the Sumzum and Guxiang populations, plantlets both from seedlings and root turions were found, and individuals in these two populations were scattered. However, in the three populations in Nyingchi County, no seedlings were found, and all plantlets were from root turions. Individuals in

these three populations were very dense and formed colonies. It appears that each of these three populations was a clone resulting from a single individual, and that they were introduced and naturalized by cloning.

*Paeonia delavayi* has the widest distribution of any woody species of the genus, and it grows in N Yunnan, SW Sichuan, and adjacent SE corner of Xizang.

*Specimens examined.* CHINA. **SE Xizang:** Zayu County: Goyu (Goqen), 3300 m, *Plant Resources Expedition of Xizang Plateau Inst. Biol. 3895* (XZ), 3100 m, *Ni, Wang, Ciduo & Cidan 1051* (PE, XZ); Zawalong, Songta Snow Mountain, 2800–3100 m, *Qinghai-Xizang Exped. 7673* (KUN); Bomi County: Sumzum Township, Sumzum, near village S of Parong Zangbo (River), 3100 m, *Hong, Luo & Zhang H96028* (GH/A, K, MO, PE, S); Guxiang Township, Gucun village, 29.9°N, 95.5°E, 2600 m, *Hong, Luo & Zhang H96024* (GH/A, K, MO, PE, S), *Ying & Hong 39, 214* (PE); between Zamu and Guxiang, 2700 m, *Zhang & Lang 379* (PE); near Bomi, valley behind army station, 2700 m, *Xiao, Xia & Mi 2233* (KUN); Nyingchi County: 0.5 km N of Nyingchi Town, W side of highway, 2950 m, *Hong, Luo & Zhang H96019* (GH/A, K, MO, PE, S); Bayi Town, Juemugou, 2950 m, *Hong, Luo & Zhang H96004* (GH/A, K, MO, PE, S); Xituan Village, Genzhang Nongba (valley), on ruins of temple, 3200 m, *Hong, Luo & Zhang H96003* (GH/A, K, MO, PE, S).

***Paeonia sterniana* Fletcher, J. Roy. Hort. Soc. 84: 326, t. 103. 1959.** TYPE: China. SE Xizang: Kongbo, Tsangpo Valley, between Tripe and Gyala, 2830 m, 24 Apr. 1947, *Ludlow, Sherriff & Elliot 13543* (holotype, BM).

This species is endemic to SE Xizang.

*Specimens examined.* CHINA. **SE Xizang:** Zayu County: between Goyu and Cinong, 3300 m, *Qinghai-Xizang Expedition 73-294* (PE); Bomi County: Yipuxang, 3300 m, *Fei, Sun, Li & Bai 244* (KUN); Sumzum Township, S of Parong Zangbo (River), 3100 m, *Hong, Luo & Zhang H96030* (GH/A, K, MO, PE, S); Sumzum Township, Mimi, 3500 m, *Ying & Hong 1097* (PE); between Bomi and Ranwu, 3500 m, *Ni, Wang, Ciduo & Cidan 133* (PE, XZ); Bomi, between Bomi and Ranwu, 3350 m, *Naito, Lang, Tateishi, Nemoto & Li 763* (PE); Ranwu to Bomi, 85 km, *Fei, Sun, Li & Bai 145* (KUN); Sumzum to Aguo, 3000 m, *Xizang Supl. Exped. Wu 5930* (KUN).

***Paeonia emodi* Wallich ex Royle, Ill. Bot. Himal. 57. 1834.** TYPE: India. Kumaon, Shallom, *Wallich 4727* (holotype, K).

The species is widely distributed in N Pakistan, NW India, and W Nepal. It is known from a single locality in China.

*Specimen examined.* CHINA. **SW Xizang:** Gyirong County, Jiangcun, E slope, 2350 m, *Xizang Chinese Traditional Medicinal Plant Expedition 413* (PE).

***Paeonia veitchii*** Lynch, Gard. Chron. Ser. 3, 46: 2, t. 1. 1909. TYPE: China. Sichuan: *Wilson Veitch Expedition 3034, 3036* (syntypes, K).

*Specimens examined.* CHINA. **E Xizang:** Jomda County, Gangtuo District, sunny slopes, 3100 m, 27 Aug. 1976, *Qinghai-Xizang Expedition Vegetation Group 9893* (PE).

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